STUDY OF DESIGNING LIVING ZONES CONSIDERING AGED PEDESTRIANS — Focusing on the aged living in Seoul, Korea —

高齢歩行者を考慮した生活圏構 築に関する研究 — 韓国ソウルの高齢者を対象として —

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This study aimed to elucidate the proper arrangement of various daily living facilities for the aged, and the following findings were made. Because of the high level of usage of such facilities by the aged, the following four types of facilities, in order of priority, must be maintained: public administration facilities, leisure-welfare facilities, leisure-resting facilities, and welfare facilities. It is necessary to plan pedestrian walkways because the frequency of walking among the aged is higher than that among the non-aged. And, it is essential to select appropriate locations for each facility, all which should be arranged within about a 400-m radius from residential areas.

1. Introduction

1.1. Background and objectives

With a dramatic increase in the aged population, there has been a rise in the number of countries entering into an aged society. In Korea, the December 2011 data for Resident Registration Population¹⁾ show an increase of 11.2% (10.0%, Seoul) in the aged population. Interest in internal as well as external spaces utilized by the aged has risen accordingly. As Korea moves to becoming an aged society, the improvement of facilities used by the aged is required. For example, the physical conditions of housing need to be adapted. However, policy measures for living areas as well as for the external environment have rarely considered the aged. Therefore, the primary aim of the recent research²⁾⁻⁹⁾ is to develop an approach to building barrier-free living zones for main facilities in external spaces for the aged, considering that they usually move around on foot.

It is important that areas used during daily life meet the demands of and provide adequate services to residents, especially the physically weak or socially disadvantaged aged who are more in need than healthy people. However, the various facilities used most by the aged in daily life are not easily accessible currently. It is not enough to say that such facilities are suitable simply because they are available in the city.

The preferences for local facilities (e.g., housing, welfare and medical) for the aged in the city have been determined. However, each facility is standalone, functions independently, and is not integrated with other facilities¹⁰⁾. Consequently, people who use facilities are not comfortable because they have to use independent, non-connected facilities that require traveling between them. Other problems include a shortage of networked

facilities, overlapping of functions, reduced use, low levels of service and low levels of awareness by the aged. Therefore, there needs to be way to connect facilities as a network. We have studied previous research and theoretical reviews¹¹⁾⁻¹⁴⁾ that have examined the facilities needed by the aged for living, daily activities and walking in order to establish the background to connect facilities in the area that were not planned together. However, there is a lack of research considering the aged in living zones in Seoul, Korea.

This study aimed to elucidate the proper arrangement of various daily living facilities for the aged.

1.2. Methods of study

This study investigates the planning and arrangement of daily living facilities. After analyzing the combination of open and closed-ended questionnaires, the results were compared with those obtained from analyzing the results of fieldwork in Seoul, and the findings of the important facilities common to both sets of results were elucidated.

Questionnaires of the aged living in Seoul, Korea was conducted and comprised questions about usage of facilities, frequency of use, mode of transport, current traveling time and desired traveling time for daily living facilities.

A regional study on the actual life of the aged investigated two aspects in order to enhance our understanding of the distribution of the facilities and the walking environments between them.

The results of questionnaires and regional study revealed the directions required for the improvement of the functions and locations of daily living facilities for use by the aged.

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Fig.1 Flow of this research (Methods of study)

2. Theoretical Approach

2.1. An acceptable walking zone for the aged

The environments of existing administrative areas in the city do not meet the needs of aged residents who need to walk far to use them. Therefore, the planning of these areas needs to be rethought. This study only considers the horizontal moving.

An acceptable walking zone for the aged was determined by reviewing the literature on the time limits for walking without tiredness and walking speed of elderly males. The walking average speed was determined to be 0.67 m/s (aged males) and 0.71 m/s (aged females) in Korea (Yoo *et al.*¹⁵, 2001). Therefore, we took 0.67 m/s as the average which equates to half the average speed of a healthy adult; 1.2~1.4 m/s (Yoo *et al.*, 2001).

Table 1 shows time limits without tiredness (Shin¹⁶ *et al.*, 2000) and, therefore, the average time limit is determined to be 9.72 min. Therefore, the walking zone of the aged was calculated as 390.7 m according to Eq. 1.

Table.1 Walking time limits without tiredness of the aged¹⁶⁾

Walking time Age (years)	Approx. time limit (%)					Average time limit (min)	
	3 min	5 min	10 min	15 min	Total	Average 1*	Average 2**
~39	2	8	47	43	100	11.61	11.33
40~59	2	14	46	38	100	11.06	
60~69	3	15	50	32	100	10.64	9.72
70~79	3	18	52	27	100	10.24	
80~	10	35	40	15	100	8.30	

*Average 1: Average of Each 10 year

**Average 2: Average of over 60 and under 60

$$\text{An acceptable walking zone for the aged} \\ = \text{average speed} \times \text{average time limit without tiredness} \quad (1)$$

2.2. Required facilities for the aged

The physical and mental states of the aged vary widely, from being healthy and active to having a variety of physical disabilities and mental deterioration. Among the requirements of the aged, the adequacy of care facilities, public facilities and residential facilities in the physical environment are closely related to their physical, psychological and mental states. Environmental improvements should therefore remove the disabling elements to ensure an independent life for the aged and improve safety, functionality, efficiency of maintenance and

aesthetic aspects. In order to improve the quality of environments where the aged lead their daily lives, it is critical to understand interactions between the physical aspects and the other various ones including psychological and social environments. It is difficult to describe briefly the changes facing the aged, although common features can be predicted. Table 2¹⁷⁾ shows the requirements and facilities thought to be needed to accommodate such changes in the aged population.

Table.2 Requirements and necessary facilities for the aged¹⁷⁾

Change in state of the aged	Requirements and facilities needed for the aged
Physical	Medical and care facilities
Mental and psychological	Improvement of the environment
Social and economic	Livelihood protection and production activities
	Social participation
	Education and leisure activities

Currently used as well as facilities for the aged in their residential area were determined on the basis of the classification of facilities in a previous study^{14), 15)}. As mentioned, in this study, facilities were divided into 9 categories: commercial, administrative, cultural, leisure-resting, leisure-welfare, medical, welfare, religious and educational (Table 3). However, commercial complexes at commercial facilities and business facilities as well as general hospitals and public health centers at medical facilities were excluded from the analysis because they are difficult to access on foot.

Table.3 Classification of living facilities

Facilities	Type	
Commercial (CO)	Commercial (Daily)	Supermarket, Convenience store, etc.
	Commercial complex (shopping mall, department store, etc.)	Hypermarket, Traditional market, etc.
Business	Public Administration (PA)	Bank, Post office, etc.
	Company	Center for residents, City Hall, etc.
Cultural (CU)	Cultural venue, Movie theater, Library, etc.	
	Cultural Center, Sports center, Playground, etc.	
Leisure-Resting (LR)	Public park, Resting place	
Leisure-Welfare (LW)	Hall for the aged	
Medical (ME)	Drugstore	
	Nursing home	
	Public health center	
	General hospital	
Welfare (WE)	Welfare facilities	
Religious (RE)	Religious facilities	
Educational (ED)	Educational facilities (school, vocational training center, etc.)	

3. Questionnaires and interviews

The questionnaire focused on the facilities that were frequently used and those which the aged desired to use. Questionnaire and interview topics included major modes of transport, frequency of use, distance traveled, etc.

3.1. Outline of the survey

The survey(open and closed-ended questionnaires) was conducted with the pre-aged*¹⁾ and the aged*²⁾ using welfare facility or hall for the aged*³⁾ living in Seoul (Eunpyeong-Gu, Seongbuk-Gu and Guro-Gu, etc.*⁴⁾) and comprised questions regarding facilities, frequency of use, modes of transport, current traveling time and desired traveling time for each type of facility (Table 4).

Table.4 Outline of the questionnaire and interviews

Division	Contents
Survey period	January 2009–March 2009
Methodology	Questionnaire and interviews(The pre-aged) and one-on-one interviews using questionnaire(The aged)
Participants	The aged in Seoul: 127 people ; Welfare facility or Hall for the aged users lived in Eunpyeong-Gu, Seongbuk-Gu and Guro-Gu etc., 1) 62 pre-aged (50–64 years old) 2) 65 advanced-aged (65 years old and older)
Survey information	Current facilities in living areas of the aged Desired facilities for residential areas The location of the facilities used Frequency of use Modes of transport Current traveling time and desired traveling time

3.2. The location of facilities used and mode of transport

Table 5 shows that almost participants (the pre- and aged) use facilities in the living zones.

Fig.2 shows that 40.3% (The pre-aged), 50.7% (The aged) of the interviewees answered that walking was their mode of transport. Travelling on foot between facilities is the most common mode of transport for the aged. Furthermore, most of the answers were ‘Walk’ or ‘Bus or Subway’. Unlike the aged, 18% of the pre-aged used cars to access facilities. The increase in the numbers of the

pre-aged using cars will likely affect future urban planning.

Fig.2 Mode of transport for using facilities

3.3. Frequency of use and satisfaction

Leisure-resting facilities, leisure-welfare facilities (halls for the aged), welfare facilities and commercial facilities are used frequently. As age progresses, leisure-welfare facilities and welfare facilities are used more frequently (Table 5).

Table 5 shows satisfaction regarding the location of facilities on a 4-point scale (very satisfied, satisfied, dissatisfied and very dissatisfied). However, it shows the satisfaction score for only those who responded to the question (n=127).

For the pre-aged, the highest satisfaction with respect to distance and use was found for leisure-resting facilities (parks), public administration facilities and religious facilities, whereas those which showed the lowest satisfaction were educational facilities, welfare facilities and commercial facilities.

For the aged, the facilities which showed the highest

Table. 5 Result of questionnaire and interviews

Facilities	Participants	The location of facilities used ³⁾				Mode of transport										Frequency of use										Average of satisfaction score		
		In the living zones		Out of the living zones		walk		Bus or sub.		Car		Wheelchair ⁴⁾		others		No answer		Everyday		2~3times /week		2~3times /Month		2~3times /year			Don't use	
		N.S.5)	P6)	N.S.	P	N.S.	P	N.S.	P	N.S.	P	N.S.	P	N.S.	P	N.S.	P	N.S.	P	N.S.	P	N.S.	P	N.S.	P		N.S.	P
Commercial (daily) (CO)	Pre-aged ¹⁾	77	91.7%	7	8.3%	51	41.1%	5	4.0%	20	16.1%	5	4.0%	0	0.0%	43	34.7%	9	7.2%	44	35.5%	24	19.4%	4	3.2%	43	34.7%	2.87
	Aged ²⁾	70	94.6%	4	5.4%	52	21.9%	8	3.4%	11	4.6%	35	14.8%	73	30.8%	58	24.5%	15	11.5%	35	26.9%	14	10.8%	3	2.3%	63	48.5%	3.12
	Average	147	93.0%	11	7.0%	103	33.2%	17	4.2%	31	10.0%	5	1.9%	3	1.8%	101	32.6%	24	9.4%	79	31.1%	38	15.0%	7	2.8%	106	41.7%	2.77
Public Administration (PA)	Pre-aged	84	93.3%	6	6.7%	58	46.8%	8	6.5%	12	9.7%	7	5.6%	0	0.0%	39	31.5%	4	3.2%	18	14.5%	38	30.7%	21	16.9%	43	34.7%	3.13
	Aged	71	94.7%	4	5.3%	60	31.3%	7	3.6%	4	2.1%	3	1.6%	62	32.3%	56	29.2%	1	0.8%	15	11.5%	42	32.3%	12	9.2%	60	46.2%	2.88
	Average	155	93.9%	10	6.1%	118	46.5%	15	5.9%	16	6.3%	8	3.1%	2	0.8%	95	37.4%	5	2.0%	33	13.0%	80	31.5%	33	13.0%	103	40.5%	3.01
Cultural (CU)	Pre-aged	71	72.9%	19	27.1%	22	17.7%	10	8.1%	11	8.9%	2	1.6%	0	0.0%	79	63.7%	11	8.9%	6	4.8%	15	12.1%	14	11.3%	78	62.9%	3.02
	Aged	74	79.2%	11	20.8%	12	9.2%	9	6.9%	1	0.8%	1	0.8%	0	0.0%	107	82.3%	3	2.3%	7	5.4%	8	6.1%	4	3.1%	108	83.1%	2.84
	Average	145	74.9%	30	25.1%	34	13.4%	19	7.5%	12	4.7%	3	1.2%	0	0.0%	186	73.2%	14	5.5%	13	5.1%	23	9.1%	18	7.1%	186	73.2%	2.97
Leisure-Resting (LR)	Pre-aged	31	83.8%	6	16.2%	26	41.9%	1	1.6%	3	4.8%	3	4.8%	1	1.6%	28	45.2%	7	11.3%	15	24.2%	7	11.3%	5	8.1%	28	45.1%	3.00
	Aged	21	80.8%	5	19.2%	18	27.7%	3	4.6%	3	4.6%	0	0.0%	2	3.1%	39	60.0%	4	6.1%	11	16.9%	4	6.2%	4	6.2%	42	64.6%	3.24
	Average	52	82.6%	11	17.4%	44	34.6%	4	3.1%	6	4.7%	3	2.4%	3	2.4%	67	52.8%	11	8.6%	26	20.5%	11	8.7%	9	7.1%	70	55.1%	3.24
Leisure-Welfare (LW)	Pre-aged	1	100.0%	0	0.0%	1	1.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	61	98.4%	0	0.0%	1	1.6%	0	0.0%	0	0.0%	61	98.4%	3.16
	Aged	34	97.1%	1	2.9%	25	38.5%	7	10.8%	0	0.0%	0	0.0%	3	4.6%	30	46.1%	28	43.1%	5	7.7%	1	1.5%	0	0.0%	31	47.7%	3.00
	Average	35	94.6%	2	5.4%	26	20.5%	7	5.5%	0	0.0%	0	0.0%	3	2.4%	91	71.7%	28	22.1%	6	4.7%	1	0.8%	0	0.0%	92	72.4%	3.09
Medical (ME)	Pre-aged	113	95.8%	5	4.2%	74	39.8%	19	10.2%	7	3.8%	15	8.1%	0	0.0%	71	38.2%	2	1.1%	11	5.9%	61	32.8%	41	22.0%	71	38.2%	2.96
	Aged	92	97.9%	2	2.1%	62	31.8%	17	8.7%	7	3.6%	2	1.0%	3	1.5%	104	53.3%	1	0.5%	12	6.1%	52	26.7%	22	11.3%	108	55.4%	3.00
	Average	205	96.7%	7	3.3%	136	35.7%	36	9.4%	14	3.7%	17	4.5%	3	0.8%	175	45.9%	3	0.8%	23	6.0%	113	29.7%	63	16.5%	179	47.0%	2.97
Welfare (WE)	Pre-aged	22	84.6%	4	15.4%	11	17.7%	7	11.3%	0	0.0%	4	6.5%	0	0.0%	40	64.5%	7	11.3%	7	11.3%	5	8.1%	2	3.2%	41	66.1%	2.85
	Aged	33	97.1%	1	2.9%	15	23.1%	15	24.6%	1	1.5%	1	1.5%	0	0.0%	32	49.2%	14	21.5%	14	21.5%	2	3.1%	0	0.0%	35	53.9%	3.17
	Average	55	91.7%	5	8.3%	26	20.5%	23	18.1%	1	0.8%	5	3.9%	0	0.0%	72	56.7%	21	16.5%	21	16.5%	7	5.5%	2	1.6%	76	59.9%	3.04
Religious (RE)	Pre-aged	18	66.7%	9	33.3%	14	22.6%	5	8.1%	5	8.1%	2	3.2%	0	0.0%	36	58.1%	2	3.2%	15	24.2%	8	12.9%	1	1.6%	36	58.1%	3.12
	Aged	33	76.7%	10	23.3%	25	38.5%	14	21.5%	3	4.6%	0	0.0%	1	1.5%	22	33.8%	2	3.1%	25	38.5%	9	13.8%	6	9.2%	23	35.4%	3.10
	Average	51	72.9%	19	27.1%	39	30.7%	19	15.0%	8	6.3%	2	1.6%	1	0.8%	58	45.7%	4	3.1%	40	31.5%	17	13.4%	7	5.5%	59	46.5%	3.11
Educational (ED)	Pre-aged	8	80.0%	2	20.0%	4	6.5%	4	6.5%	0	0.0%	1	1.6%	0	0.0%	53	85.5%	2	3.2%	5	8.1%	2	3.2%	1	1.6%	52	83.9%	2.78
	Aged	8	100.0%	0	0.0%	6	9.2%	2	3.1%	0	0.0%	0	0.0%	0	0.0%	57	87.7%	2	3.1%	5	7.7%	1	1.5%	0	0.0%	57	87.7%	2.86
	Average	16	88.9%	2	11.1%	10	7.9%	6	4.7%	0	0.0%	1	0.8%	0	0.0%	110	86.6%	4	3.1%	10	7.9%	3	2.4%	1	0.8%	109	85.8%	2.81

1)Pre-aged: 50-64 years old / 2)Aged: 65 years old and older / 3)Not including Don't use and No answer/ 4)Including E-wheelchair/ 5)Number of Sample/ 6)Percentage

satisfaction with respect to distance and use were the leisure-welfare facilities, welfare facilities and commercial facilities. Those which showed the lowest satisfaction were cultural facilities, educational facilities and public administration facilities.

The aged are more satisfied than the pre-aged with commercial facilities, implying that the aged use commercial facilities nearby more frequently than the pre-aged. Therefore, when considering the aged, planning for welfare facilities and commercial facilities should be a priority. In this study, however, commercial facilities which are strongly influenced by the market economy are not considered as main facilities. We will handle the case of commercial facilities separately in the hereafter research.

3.4. Current traveling time and desired traveling time

Distance was divided into varying times (10, 20 and 30 min) on the basis of the average time (9.7 min, Table 1) taken to walk a particular distance (390.7 m) by the aged. Next, we inquired about current and desired traveling times to the facilities within the “living zone” of the respondents. Taking the average male walking speed of 0.67m/s(=40.2 m/min.), spatial distances were obtained for 402m, 804m, 1206m and 2412m.

Table 6 shows that most of the aged take less than 10 minutes to access facilities. However, 42 % ~ 76 % of the pre-aged and 11 % ~ 45 % of the aged answered that they move to facilities in 20 minutes and more. In the case of welfare and religious facilities, 72 % ~ 73 % of the aged takes in 20 minutes and more to access to these facilities which usually move by shuttle-bus. For the aged, public administration and leisure-resting show the biggest difference between current traveling distance and the

desired traveling distance. In addition, public administration facilities (Center for residents^{5b)}) can be considered as a main facility because the current traveling distance of public administration facilities have adequate distance and have been located in every Dong^{6a)} unit. The aged want to approach welfare facilities easily while the pre-aged want to approach leisure-resting facilities like parks easily. But, for the pre-aged, commercial and cultural facilities the biggest difference between current distance and desired distance.

4. Regional study

Two areas inhabited by a high number of aged people in Seoul were selected for study. We compared the current and desired traveling distance of facilities in the selected areas with the distances obtained in the survey. After comparing the data of the aged with respect to walking distance (about 400 m), we reviewed the results for accessibility.

4.1. Outline of the survey

First, the walking distance limit of the aged was calculated using Eq. 1, and was determined as approximately 400 m. For analysis, we used a 700 m × 700 m (350 m~424 m radius) module that included the limited walking distance of the aged. The module was then positioned to be central to all facilities. This method simplified the understanding of the density of an approach to facilities (Table 7).

Among the 9 categories of facilities, the public administration facilities (e.g., centers for residents) and leisure resting facilities (e.g., public parks, resting places), leisure-welfare facilities (e.g., halls for the aged) and welfare facilities were determined as the

Table.6 The current and desired traveling distances

			CO		PA		CU		LR		LW		ME		WE		RE		ED	
Pre-aged	Current traveling distance	10 min.(402m)	44%	44%	53%	53%	36%	36%	58%	58%	100%	100%	52%	52%	20%	20%	24%	24%	33%	33%
		20 min.(804m)	41%		30%		33%		21%		0%		31%		35%		44%		22%	
		30min.(1206m)	9%	56%	15%	47%	16%	64%	6%	42%	0%	0%	9%	48%	15%	80%	16%	76%	22%	67%
		60min.(2412m)	6%		2%		16%		15%		0%		8%		30%		16%		22%	
		N.S.*	124		124		124		62		62		186		62		62		62	
		N.V.R**	81		81		45		33		1		113		20		25		9	
		S.D.***	493.4		400.7		675.3		702.3		0.0		550.0		786.5		654.0		752.7	
	Desired traveling distance	10 min.(402m)	60%	60%	42%	42%	50%	50%	42%	42%	69%	69%	51%	51%	27%	27%	28%	28%	14%	14%
		20 min.(804m)	22%		48%		15%		21%		16%		34%		53%		36%		43%	
		30min.(1206m)	12%	40%	9%	58%	25%	50%	29%	58%	9%	31%	13%	49%	10%	73%	15%	72%	43%	86%
		60min.(2412m)	6%		1%		10%		8%		6%		2%		10%		21%		0%	
		N.S.	124		124		124		62		62		186		62		62		62	
		N.V.R	67		69		20		24		32		87		30		39		7	
		S.D.	333.1		227.9		490.6		291.8		134.8		435.8		551.7		562.6		764.0	
Aged	Current traveling distance	10 min.(402m)	60%	60%	42%	42%	50%	50%	42%	42%	69%	69%	51%	51%	27%	27%	28%	28%	14%	14%
		20 min.(804m)	22%		48%		15%		21%		16%		34%		53%		36%		43%	
		30min.(1206m)	12%	40%	9%	58%	25%	50%	29%	58%	9%	31%	13%	49%	10%	73%	15%	72%	43%	86%
		60min.(2412m)	6%		1%		10%		8%		6%		2%		10%		21%		0%	
		N.S.	130		130		130		65		65		195		65		65		65	
		N.V.R	67		69		20		24		32		87		30		39		7	
		S.D.	510.8		327.4		613.3		568.3		518.4		385.0		555.9		723.5		281.3	
	Desired traveling distance	10 min.(402m)	74%	74%	80%	80%	48%	48%	77%	77%	94%	94%	88%	88%	89%	89%	63%	63%	63%	63%
		20 min.(804m)	15%		19%		30%		19%		4%		8%		7%		17%		25%	
		30min.(1206m)	7%	26%	2%	20%	19%	52%	4%	23%	2%	6%	3%	12%	5%	11%	10%	37%	13%	38%
		60min.(2412m)	5%		0%		4%		0%		0%		1%		0%		10%		0%	
		N.S.	130		130		130		65		65		195		65		65		65	
		N.V.R	61		54		27		26		50		90		44		30		8	
		S.D.	469.5		184.2		447.2		210.3		135.5		269.3		190.6		611.7		284.3	

*N.S.:Number of samples, **N.V.R:Number of valid responses, ***S.D.:Standard deviation

main facilities on the basis of the results of the survey for the aged. The target locations were situated across Eunpyeong-gu and Nowon-gu (an area of 2800 m × 3400 m; 9.52 km², equivalent to 3~4 Dong units). These areas were selected according to the prevalence of aged inhabitants as a proportion of the local population.

4.2. Arrangement of facilities

The table 7 shows location of 4 main facilities, number of facilities, an acceptable walking zone and the ratio of this zone for the aged.

In the regional survey of A area where is the existing old build-up area, the extent of the acceptable walking zone for the aged is 4.23 km²~4.52 km² excluded the welfare facility around (2.45 km²). In other words, the ratio of the acceptable walking zone for the aged is 44%~47% (a welfare facility: 25 %). In the investigation of B area where is the new-town area, the extent of the acceptable walking zone for the aged is 4.56 km²~5.46 km² excluded the welfare facility around (3.94 km²) and the ratio of the acceptable walking zone for the aged is 48 %~57 % (a welfare facility: 41 %). In the case of welfare facilities should be made transportation to them (such as public transportation and specialized transportation) must be easily accessible.

Table 7 shows that the facilities of A area (Eunpyeong-gu : old built-up area) are widely distributed, whereas the facilities of B area (Nowon-gu : new town area) have been planned compactly. It will therefore be necessary to plan placement of facilities according to the characteristics of the local area.

5. Conclusion

This study aimed to elucidate the proper arrangement of various daily living facilities for the aged from use theoretical data, questionnaires and regional study. The following findings were made.

Firstly, because of the high level of usage of such facilities by the aged, the following four types of facilities, in order of priority, must be maintained: public administration facilities, leisure-welfare facilities, leisure-resting facilities, and welfare facilities. Most importantly, public administration facilities (e.g., centers for residents) should be improved because these facilities are currently widely distributed across the Dong unit of the city.

Secondly, it is necessary to plan pedestrian walkways because the frequency of walking among the aged is higher than that among the non-aged. And, it is essential to select appropriate locations for each facility, all which should be arranged within about a 400-m radius from residential areas and which the aged can reach within 10 min on foot considering the distance which the aged can comfortably walk without stopping.

Thirdly, it is different between the comfortably walking distance (390.7 m) and the desired distance (about 400~500m) for using main facilities. And the result of the regional study shows that the ratio of the acceptable walking zone for the aged is only 44 %~47 % (in case of A area). The aged to use facilities in the living zone on foot feel uncomfortable. Therefore, the living zone of the aged is smaller than the existing living zone. And by placing rest areas along walkways can help to make walking

Table.7 Results of regional study

Categories		Facilities	Public Administration (Center for residents)	Leisure-Welfare (Center for the aged)	Leisure-Resting (Park)	Welfare
Result of regional study	A area, 9.52km ² (Eunpyeong-Gu : Old built-up area) Population of Eunpyeong-Gu in 2011 Population: 498,350 The aged: 56,595 11.4% (Http://stat.seoul.go.kr)	The location of facilities
		N.F.*(E.A.W.Z**)	10 (4.52km ²)	12 (4.29km ²)	10 (4.23km ²)	6 (2.45km ²)
		R.A.W.Z***	47% (4.52/9.52)	45% (4.29/9.52)	44% (4.23/9.52)	25% (2.45/9.52)
	B area, 9.52km ² (Now on-Gu : New town area) Population of Now on-Gu in 2011 Population: 608,062 the aged: 58,642 9.6% (Http://stat.seoul.go.kr)	The location of facilities
		N.F.*(E.A.W.Z**)	13 (4.56km ²)	32 (5.46km ²)	23 (5.34km ²)	12 (3.94km ²)
		R.A.W.Z***	48% (4.56/9.52)	57% (5.46/9.52)	56% (5.34/9.52)	41% (3.94/9.52)

*The number of facilities / **The extent of the acceptable walking zone for the aged / ***The ratio of the acceptable walking zone for the aged

more convenient in the wide expanse of the living zone.

Fourthly, the required functions should be incorporated into existing facilities. Otherwise, in the case that there is no proper arrangement of facilities in the city, additional facilities should be arranged by considering the time unit of 10 min that the aged need to reach them. Moreover, efficiency for use of facilities in daily living zones can be enhanced by connecting specialized modes of transport for the aged. Increasing the workforce available to support the aged in walking may further ease the difficulties that they may experience when traveling to and utilizing facilities.

This study has the limit in that most people who had participated survey and interview use particular facilities for the aged (such as welfare facilities, halls for the aged, etc.) and live in many quarters in Seoul. This study, however, public administration facilities which are currently widely distributed across the Dong unit of the city are high usability as main facilities. Our next target of research will be the aged who use particular facilities as well as live in the specific area. In addition, survey of targeted location (old built-up and new town area) placed facilities for the aged will be needed.

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Notes

- *1) 'The pre-aged' refers to people who are 50–64 years old.
- *2) 'The aged' and the 'the advanced-aged' refers to people who are 65 years old and older.
- *3) 'Halls for the aged' ('Gyung-Ro-Dang' in Korean) means the facility made to honor the aged so they can enjoy their leisure time.
- *4) Basic information of the survey areas is as follows.

Table.8 Information of the survey area

	Area	Population (2011.12)	Number of the aged	Percentage of the aged	Location
Seoul	605.25 ^{km²}	10,528,774	1,049,425	10.0%	-
Eunpyeong-Gu	29.71 ^{km²}	498,350	56,595	11.4%	Northwest of Seoul
Seongbuk-Gu	24.57 ^{km²}	494,422	55,213	11.2%	North of Seoul
Guro-Gu	20.12 ^{km²}	458,908	41,992	9.2%	Southwest of Seoul
Nowon-gu	35.42 ^{km²}	608,062	58,642	9.6%	Northeast of Seoul

- *5) 'Center for residents' ('Ju-Min-Ja-Chi-Center' in Korean) means the facility that operates recreational activities (cultural, welfare, information, hobbies, etc.) for residents by utilizing spaces while performing civil administration.
- *6) 'Dong' is the smallest administration unit in Korea

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和文要約

本研究は、高齢歩行者のバリアフリー生活圏構築のための施設の適切な配置・アクセスや日常生活施設の間のネットワークなどの地域計画の方向性を示すのが目的である。調査は韓国ソウルの高齢者を対象とし、アンケート調査やインタビュー調査、地域調査を行った。そして、調査から出た結果と提案は以下のとおりである。

まず、アンケートの結果からの高齢者による使用が多い4施設(役所などの公共施設、敬老堂、公園などの休憩施設、福祉施設)を優先して整備しなければならない。そして、施設の適切な配置は、約400メートル以下の距離、すなわち高齢者が徒歩で約10分以内に施設の配置や連携のための再整備が必要である。

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